

CLAIMS

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1. A method of determining a time delay for a round-trip transmission of data comprising:
- receiving a first data packet comprising a first IP source address, a first IP destination address, a first TCP source port, a first TCP destination port, and a first time stamp indicating a first time when the first data packet was transmitted;
 - inserting the first IP destination address as a second IP source address in a second data packet;
 - inserting the first IP source address as a second IP destination address in the second data packet;
 - inserting the first TCP destination port as a second TCP source port in the second data packet;
 - inserting the first TCP source port as a second TCP destination port in the second data packet;
 - inserting the first time stamp as a second time stamp in the second data packet; and
 - transmitting the second data packet.
2. The method of claim 1 further comprising:
- transmitting the first data packet at the first time;
 - receiving the second data packet at a second time; and
 - determining a difference between the first time in the second time stamp and the second time to establish the time delay for the round-trip transmission of data.

1 3. The method of claim 1 further comprising:
2 validating the first IP destination address while receiving the first data packet, before
3 inserting the first IP destination address, before inserting the first IP source address, before
4 inserting the first TCP destination port, before inserting the first TCP source port, and before
5 transmitting the second data packet; and

6 validating the first TCP destination port while receiving the first data packet, before
7 inserting the first IP destination address, before inserting the first IP source address, before
8 inserting the first TCP destination port, before inserting the first TCP source port, and before
9 transmitting the second data packet.

10 4. The method of claim 1 wherein:
11 inserting the first IP destination address occurs while transmitting the second data packet;
12 and
13 inserting the first IP source address occurs while transmitting the second data packet.

14 5. The method of claim 1 wherein:
15 inserting the first TCP destination port occurs while transmitting the second data packet;
16 and
17 inserting the first TCP source port occurs while transmitting the second data packet.

- 1 6. The method of claim 1 wherein:
2 inserting the first time stamp occurs while transmitting the second data packet.
- 3 7. The method of claim 1 further comprising:
4 providing the first data packet to further comprise a first IP checksum, a first TCP
5 checksum, and a first CRC checksum;
6 validating the first IP checksum while receiving the first data packet;
7 validating the first TCP checksum while receiving the first data packet; and
8 validating the first CRC checksum.
- 9 8. The method of claim 7 further comprising:
10 storing the first IP source address and the first IP destination address before validating the
11 first IP checksum; and
12 storing the first TCP source port and the first TCP destination port after validating the
13 first IP checksum and before validating the first TCP checksum.
- 14 9. The method of claim 7 wherein:
15 validating the first TCP checksum occurs after validating the first IP checksum and
16 before validating the first CRC checksum.
- 17 10. The method of claim 7 wherein:
18 validating the first CRC checksum occurs after receiving the first data packet.

1 11. The method of claim 7 further comprising:
2 determining a second IP checksum for the second data packet;
3 inserting the second IP checksum into the second data packet while transmitting the
4 second data packet;
5 determining a second TCP checksum for the second data packet; and
6 inserting the second TCP checksum into the second data packet while transmitting the
7 second data packet.

8 12. The method of claim 11 wherein:
9 inserting the first IP destination address occurs while transmitting the second data packet;
10 inserting the first IP source address occurs while transmitting the second data packet;
11 inserting the first TCP destination port occurs while transmitting the second data packet;
12 inserting the first TCP source port occurs while transmitting the second data packet; and
13 inserting the first time stamp occurs while transmitting the second data packet.

14 13. The method of claim 11 wherein:
15 inserting the first IP destination address occurs after inserting the second IP checksum;
16 inserting the first IP source address occurs after inserting the first IP destination address;
17 inserting the first TCP destination port occurs after inserting the first IP source address;
18 and
19 inserting the first TCP source port occurs after inserting the first TCP destination port and
20 before inserting the second TCP checksum.

1 14. The method of claim 1 further comprising:

2 providing the first data packet to further comprise a first data pattern; and

3 inserting a second data pattern into the second data packet.

4 15. The method of claim 14 wherein:

5 inserting the second data pattern occurs while transmitting the second data packet.

6 16. The method of claim 1 further comprising:

7 providing the first data packet to further comprise a first TCP flag; and

8 inserting the first TCP flag as a second TCP flag into the second data packet.

9 17. The method of claim 16 further comprising:

10 validating the first TCP flag while receiving the first data packet, before inserting the first
11 IP destination address, before inserting the first IP source address, before inserting the first TCP
12 destination port, before inserting the first TCP source port, before transmitting the second data
13 packet, and before inserting the first TCP flag.

14 18. The method of claim 16 wherein:

15 inserting the second TCP flag occurs while transmitting the second data packet.

1 19. The method of claim 1 further comprising:
2 providing the first data packet to further comprise two TCP flags;
3 inserting the two TCP flags into the second data packet;
4 inserting an additional TCP flag into the second data packet, the additional TCP flag
5 having a value of one; and
6 inserting three additional TCP flags into the second data packet, the three additional TCP
7 flags each having a value of zero.

8 20. The method of claim 1 further comprising:
9 providing the first data packet to further comprising six TCP flags;
10 inserting two of the six TCP flags into the second data packet;
11 inserting an additional TCP flag into the second data packet, the additional TCP flag
12 having a value of one; and
13 inserting three additional TCP flags into the second data packet, the three additional TCP
14 flags each having a value of zero.

15 21. The method of claim 20 further comprising:
16 providing a FIN flag and a SYN flag for the two of the six TCP flags; and
17 providing an ACK flag for the additional TCP flag.

18 22. The method of claim 1 further comprising:
19 providing the first data packet to further comprise a first IP checksum, first TCP flags, a
20 first TCP checksum, and a first CRC checksum;

1 validating the first IP checksum while receiving the first data packet;
2 validating the first TCP checksum while receiving the first data packet;
3 validating the first CRC checksum after receiving the first data packet;
4 determining a second IP checksum for the second data packet;
5 inserting and the second IP checksum into the second data packet while transmitting the
6 second data packet;
7 inserting the first TCP flags as second TCP flags into the second data packet while
8 transmitting the second data packet;
9 determining a second TCP checksum for the second data packet;
10 inserting the second TCP checksum into the second data packet while transmitting the
11 second data packet;
12 determining a second CRC checksum for the second data packet; and
13 inserting the second CRC checksum into the second data packet while transmitting the
14 second data packet.

15 23. The method of claim 22 wherein:

16 inserting the first IP destination address occurs while transmitting the second data packet;
17 inserting the first IP source address occurs while transmitting the second data packet;
18 inserting the first TCP destination port occurs while transmitting the second data packet;
19 inserting the first TCP source port occurs while transmitting the second data packet; and
20 inserting the first time stamp occurs while transmitting the second data packet.

1 24. The method of claim 23 wherein:
2 inserting the first IP destination address occurs after inserting the second IP checksum;
3 inserting the first IP source address occurs after inserting the first IP destination address;
4 inserting the first TCP destination port occurs after inserting the first IP source address;
5 inserting the first TCP source port occurs after inserting the first TCP destination port;
6 inserting the first TCP flags occurs after inserting the first TCP source port;
7 inserting the second TCP checksum occurs after inserting the first TCP flags;
8 inserting the first time stamp occur after inserting the second TCP checksum; and
9 inserting the second CRC checksum occurs after inserting the first time stamp.

10 25. The method of claim 24 further comprising:
11 providing the first data packet to further comprise a first data pattern; and
12 inserting a second data pattern into the second data packet while transmitting the second
13 data packet.

14 26. The method of claim 25 further comprising:
15 transmitting the first data packet at the first time from a first electronic apparatus having
16 the first IP source address and the first TCP source port;
17 receiving the second data packet at a second time and at the first electronic apparatus
18 having the second IP destination address and the second TCP destination port; and
19 subtracting the first time in the second time stamp from the second time to determine the
20 time delay for the round-trip transmission of data,

1 wherein:

2 receiving the first data packet further comprises receiving the first data packet at a
3 second electronic apparatus having the first IP destination address and the first TCP destination
4 port; and

5 transmitting the second data packet further comprises transmitting the second data
6 packet from the second electronic apparatus having the second IP source address and the second
7 TCP source port.

8 27. The method of claim 22 wherein:

9 inserting the first IP destination address occurs after inserting the second IP checksum;
10 inserting the first IP source address occurs after inserting the first IP destination address;
11 inserting the first TCP destination port occurs after inserting the first IP source address;
12 inserting the first TCP source port occurs after inserting the first TCP destination port;
13 inserting the first TCP flags occurs after inserting the first TCP source port;
14 inserting the second TCP checksum occurs after inserting the first TCP flags;
15 inserting the first time stamp occur after inserting the second TCP checksum; and
16 inserting the second CRC checksum occurs after inserting the first time stamp.

17 28. The method of claim 22 further comprising:

18 providing the first data packet to further comprise a first data pattern; and
19 inserting a second data pattern into the second data packet while transmitting the second
20 data packet.

1 29. The method of claim 22 further comprising:
2 transmitting the first data packet at the first time from a first electronic apparatus having
3 the first IP source address and the first TCP source port;
4 receiving the second data packet at a second time and at the first electronic apparatus
5 having the second IP destination address and the second TCP destination port; and
6 subtracting the first time in the second time stamp from the second time to determine the
7 time delay for the round-trip transmission of data,
8 wherein:
9 receiving the first data packet further comprises receiving the first data packet at a
10 second electronic apparatus having the first IP destination address and the first TCP destination
11 port; and
12 transmitting the second data packet further comprises transmitting the second data
13 packet from the second electronic apparatus having the second IP source address and the second
14 TCP source port.

15 30. The method of claim 1 further comprising:
16 waiting for the first data packet;
17 checking a status of a first memory portion;
18 storing a portion of the first data packet if the first memory portion is available, the
19 portion of the first memory portion comprising the first IP source address, the first IP destination
20 address, the first TCP source port, and the first TCP destination port;

1 checking a validity of the first data packet;
2 setting the status of the first memory portion to full if the first data packet is valid;
3 checking a status of a second memory portion;
4 transferring the portion of the first data packet from the first memory portion to the
5 second memory portion if the second memory portion is available and if the first data packet is
6 valid;
7 setting the status of the second memory portion to full; and
8 setting the status of the first memory portion to empty.

9 31. An electronic apparatus for determining a time delay for a round-trip transmission
10 of data comprising:

11 a data reception portion;
12 an input memory portion coupled to the data reception portion;
13 a data validity portion coupled to the data reception portion;
14 a first memory and data transfer management portion coupled to the input memory
15 portion and the data validity portion;
16 a second memory and data transfer management portion coupled to the first memory and
17 data transfer management portion;
18 an output memory portion coupled to the input memory portion and the second memory
19 and data transfer management portion;
20 a data pattern management portion coupled to the second memory and data transfer
21 management portion;

1 a header format portion coupled to the output memory portion; and
2 a data transmission portion coupled to the header format portion and the data pattern
3 management portion.

4 32. The electronic apparatus of claim 31 further comprising:
5 an incoming data portion comprising:
6 the data reception portion;
7 the input memory portion;
8 the data validity portion; and
9 the first memory and data transfer management portion; and
10 an outgoing data portion comprising:
11 the second memory and data transfer management portion;
12 the output memory portion;
13 the data pattern management portion;
14 the header format portion; and
15 the data transmission portion.

16 33. The electronic apparatus of claim 31 wherein:
17 the input memory portion stores a portion of an incoming data packet;
18 the first and second memory and data transfer management portions manage a transfer of
19 the portion of the incoming data packet from the input memory portion to the output memory
20 portion;

1 the data validity portion validates the incoming data packet;
2 the output memory portion receives the portion of the incoming data packet from the
3 input memory portion;
4 the data pattern management portion manages an insertion of a data pattern into an
5 outgoing data packet; and
6 a header format portion inserts an IP source address, an IP destination address, a TCP
7 source port, a TCP destination port, TCP flags, and a time stamp into the outgoing data packet.

8 34. The electronic apparatus of claim 31 wherein:
9 the input memory portion, the output memory portion, the first and second memory and
10 data transfer management portions, the data validity portion, the data reception portion, the data
11 transmission portion, the header format portion, and the data pattern management portion are
12 located within a field-programmable gate array.

13 35. The electronic apparatus of claim 31 further comprising:
14 a data pattern memory portion coupling the data pattern management portion to the data
15 transmission portion.

16 36. The electronic apparatus of claim 35 wherein:
17 the data pattern memory portion is a dynamic random access memory.

